



## Review

# Is the skeleton still in the hospital closet? A review of hospital malnutrition emphasizing health economic aspects



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## ARTICLE INFO

## Article history:

Received 8 December 2014

Accepted 15 February 2015

## Keywords:

Malnutrition  
Undernutrition  
Oral supplements  
Sip feeding  
Nutritional assessment

## SUMMARY

**Background:** Hospital malnutrition used to be a skeleton, a well hidden secret. Compelling studies in the last four decades revealed the width and depth of the problem. It encompasses not only critically ill hospitalized individuals, but many other vulnerable groups. The aim of this review was to assess the effectiveness of current hospital routines in eradicating this historical scourge.

**Methods:** Diagnosis used to rely on clinical impression or anthropometrics only. Fortunately well structured questionnaires, complemented by biochemical tests and body composition studies whenever necessary, allow precise and reproducible assessment of nutritional risk, in most age brackets and disease modalities.

**Results:** Near the end of the XIXth century many scientists believed that anatomical studies were doomed. Everything that needed to be discovered was already known: muscles, bones, joints, nerves, cardiovascular structures and other systems. Then in 1893, Wilhelm His in Switzerland discovered the eponymous His bundle. In 1906 Sunao Tawara in Japan was responsible for the concept of the atrio-ventricular conduction pathway. Combined with the advent of the electrocardiograph by Willem Einthoven in The Netherlands, in 1903, such advances extraordinarily improved the handling of heart arrhythmias. Addressing hospital malnutrition does not depend on new technologies. All the essential tools exist and have been clinically tested, as here analyzed. A simpler breakthrough is desired, namely the wider adoption of available procedures.

**Conclusion:** Four decades after a historical report, a barrier still remains in many countries, namely more effectively embedding screening and nutritional therapy tools for hospitalized patients, in the professional routine.

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## 1. Introduction

Hospital malnutrition is certainly as old as hospitals themselves, which first appeared in the Middle Ages. In a less distant past, Florence Nightingale already complained that injured soldiers, in the original Crimean War of 1853–1856, starved surrounded by plenty of food [1].

Modern attention to hospital malnutrition can be traced to a landmark article by Butterworth, in 1974. It practically coincided

with two equally classic publications by Bistran et al., which affirmed that about half of both medical and surgical patients suffered from obvious nutritional deficiencies [2,3].

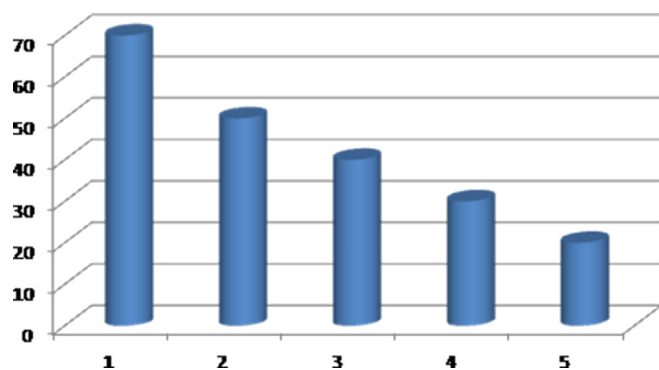
These findings catalysed a reaction by the professional and scientific community, progressively substantiated by health care authorities. Twenty years later, several festschrifts honouring the original “skeleton in the hospital closet”, including remarks by the author proper, had already much to commemorate, however still a lot to commiserate [4,5]. The panorama of a severely depleted and neglected hospitalized population was improving, however not as much as required.

### 1.1. Reports in the subsequent decades

A review addressing the period of 1980–1996 concluded that prevalence of disease-related malnutrition was 20–40%, the

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**Fig. 1.** Prevalence of malnutrition according to major diagnostic categories [5,7–12] 1: Oncology; 2: Critical disease, Respiratory, Pressure ulcers; 3) General Surgery, Gastroenterology; 4) General Medicine; 5)Gynecology, Urology, Orthopedics.

majority of the patients lacking proper nutritional records [6]. Such pattern was confirmed and even exceeded by multiple regional surveys, including the large nationwide Brazilian study started in 1996 [7,8], which revealed a global rate of 48.1% malnourished subjects (12.6% severe).

Numbers fluctuate depending on the country, nosocomial features, main diagnosis, and social-demographic characteristics (Fig. 1) [5,7–12]. Assessment tools are relevant, shifting from one investigation method to the other, as well as along the years, thus interfering with comparisons (Table 1) [13–17]. All these shortcomings notwithstanding, more than 150 surveys later, prevalence of disease-related malnutrition is still estimated as 30–50% [16], or 25–60% [14,15,17].

## 2. Importance of malnutrition

Severely undernourished or cachectic patients do not just feel socially and aesthetically handicapped. Even though partially hidden from onlookers by sheets and blankets, if not anatomically disguised by variable degrees of subcutaneous edema, their whole organism is ravaged, by silent yet dangerous physiological consequences of cell loss and functional impairment (Tables 2 and 3).

### 2.1. Readmissions, long term survival, pressure ulcers

Inadequately nourished patients don't succumb inside the hospital only. Deleterious impact on survival can be demonstrated for up to 3 years, in general populations [9,11,12,18], as well as in cardiac illnesses [19]. (Fig. 2). They are more often readmitted after discharge, further encumbering the health care system (Fig. 3) [14,15,20], and are prone to pressure ulcers, another painful and costly adverse effect (Fig. 4) [10,14,15].

**Table 1**  
Statistical comparison of nutritional assessment with SGA versus values of several screening modalities at hospital admission: NRI, MUST, NRS-2002 and CONUT [13–15].

Modality	NRI	MUST	NRS-2002	CONUT-1
Sensitivity	43.1	61.2	62.0	78.26
Specificity	89.3	78.6	93.1	89.13
Positive prognosis	76.2	64.6	85.1	84.38
Negative prognosis	66.3	76.1	79.4	84.54

NRI: Nutritional Risk Index; MUST: Malnutrition Universal Screening Tool; NRS-2002: Nutritional Risk Screening; CONUT-1:Controlling Nutritional Status.

**Table 2**  
Common undernutrition syndromes [6,14,15].

Diagnosis	Characteristics
Wasting	Loss of body cell mass without edema or hypoalbuminemia
Sarcopenia	Muscle loss predominates, with few biochemical derangements
Sarcopenic obesity	Same as sarcopenia, combined with excess body fat
Cachexia	Undernutrition with an inflammatory component. Hypoalbuminemia and edema may occur.
Protein-energy undernutrition	Loss of body cell mass related to reduced dietary intake. Hypoalbuminemia and edema may ensue.

**Table 3**  
Adverse clinical effects of malnutrition [6–12].

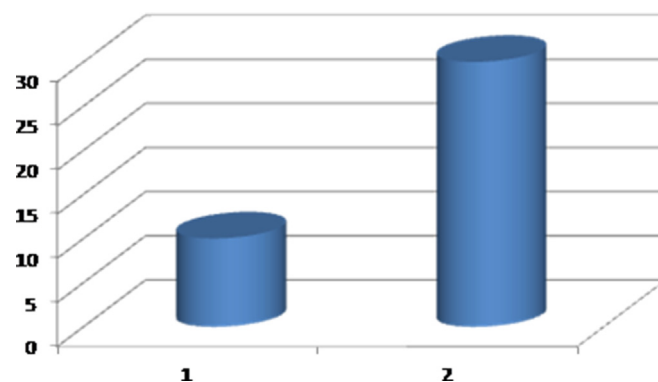
Low immune competence, infectious complications
Pressure ulcers, healing problems
Unsteady gait, falls, fractures
Impaired mental status, dependence
Treatment intolerance
Prolonged hospitalization, frequent readmissions
Poor quality of life
Worse morbidity, mortality, prognosis

## 3. Malnutrition-related expenses

Poor nutritional status is not only medically detrimental, it may also convert into a financial sinkhole. Cost analysis generally focuses prolonged hospital stay, as one day of hospitalization is a defined and quantifiable variable. Nevertheless, these patients also consume more drugs, medical and nursing assistance, diagnostic work up, and interventions to handle medical and surgical complications. Quality adjusted life years are reduced by early and late mortality, along with comorbidities and sequelae. Intensive use of health care services after discharge should not be overlooked. Indeed, many groups emphasize that hospital and posthospital malnutrition, although disease-triggered, becomes a disease-independent, highly significant cost factor. The financial burden for the patient or insurance company, the institution, and the national health care system are here considered (Table 4) [21,23–33].

## 4. Cost-benefit ratio of therapeutic intervention

As alluded to, malnourished patients incur 30–70% higher costs during the hospital stay [21]. In most countries, at least some procedures related to nutritional assistance are currently reimbursed. These encompass nutritional assessment and general nutritional replenishment plan, along with specialized



**Fig. 2.** Long term mortality according to nutritional status [9,11,12,18] 1) Well nourished; 2) Malnourished.

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